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Geoscientific Model Development Discussions

Interactive comment on "Coupling between the JULES land-surface scheme and the CCATT-BRAMS atmospheric chemistry model (JULES-CCATT-BRAMS1.0): applications to numerical weather forecasting and the CO_2 budget in South America" *by* D. S. Moreira et al.

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We thank the referee #1 for his(er) insightful and helpful comments, which contributed to improve the paper. The answers to his(er) questions/comments are below.

General comments:

1. **The abstract claims that the resulting JULES-CCATT-BRAMS modelling system that is able to give a good performance for any period of time and in any region of the globe. This has not been shown in the manuscript. In fact, the results only show that the model gives a good performance over South America. So this statement should be re-worded.**

   p. 455 line 21: The paragraph was changed to: Therefore, this work presents to the scientific community a free modeling tool, with good performance in comparison with observational data and reanalysis model data, at least for the region and time period discussed here. Nevertheless, in principle, this model is able to produce atmospheric hindcast/forecast simulations at different spatial resolutions, for any time period and any region of the globe.

2. **Both the abstract and the conclusions state that the modelling system can be made available to anyone on request to the 1st author. It also suggests that the system could be used for operational weather forecasting purposes. However, the author is not at liberty to sub-license the JULES code, under the terms of the research licence agreement, and hence the system can not be made available to anyone who has not signed the current JULES licence agreement. Hence the text should make it clear that this needs to be done. Also, the supplementary material should show this as a necessary requisite for obtaining the system. Moreover, the use of the system for operational weather forecasting is a commercial activity which is not included under the terms of the JULES licence agreement. Hence this statement in the manuscript should be removed.**

   p. 475 line 25: The following text: "JULES−CCATT−BRAMS could be utilized for operational weather forecasting as well as for research goals, for example,

the aerosol effects associated with regional smoke on the carbon cycle." was replaced by: "Instructions to compile, execute, test case and how to run the JULES−CCATT−BRAMS model can be find in the supplementary material. The code package and initial conditions for the test case can be obtained via BRAMS group at CPTEC/INPE (brams@cptec.inpe.br). However, JULES sub-model can be used only for research purposes (non-commercial use) and signing the JULES license agreement is mandatory (see: https://jules.jchmr.org/software-and-documentation)."

In supplementary material was included in item 2.1 (Requisites necessary) the sub-item: *"i) Signed the JULES licence agreement (https://jules.jchmr.org/software-and-documentation)"*

3. **p. 461. Cox et al. 2011 is a manuscript based on results from the MOSES and TRIFFID system, it is not a standard reference for MOSES and certainly not for the Unified Model. A more appropriate reference for MOSES is: Essery, R.L.H., Best, M.J., Betts, R.A., Cox, P.M., Taylor, C.M., 2003: Explicit representation of subgrid heterogeneity in a GCM land-surface scheme. Journal of Hydrometeorology, 4, 530-543. In addition, a more appropriate reference for the Unified Model would be the following website: www.metoffice.gov.uk/research/modelling-systems/unified-model**

   p. 461 line 10: The reference Essery et al., 2003 was included. p.461 line 11: Was excluded the reference Cox et. al, 2000 was excluded, instead we refer to the link www.metoffice.gov.uk/research/modelling-systems/unified-model

4. **p. 461. The wording of this section is miss-leading. JULES has been developed from the MOSES and TRIFFID schemes, but they are not identified**

   as two principle components of JULES. This section should be re-written to reflect this.

   p. 461 line 9: The paragraph was changed to: "The "Joint UK Land Environment Simulator" is a soil/vegetation model developed from the Met Office Surface Exchange Scheme (MOSES) (Essery et al., 2003) and Top-down Representation of Interactive Foliage and Flora Including Dynamics (TRIFFID). MOSES is responsible for the simulation of surface energy fluxes and hydrological processes and is the surface model used in the UK Met Office unified model (www.metoffice.gov.uk/research/modelling-systems/unified-model). TRIFFID is designed to simulate vegetation and soil dynamics."

5. **p. 461. line 24. Describing JULES as having the 5 modules as discuss here is missleading. The JULES are based around the boxes shown in Fig. 1. I would suggest that the text here is replaced with "The physics of JULES can be considered to fall into 5 areas"**

   The text "The physics of JULES can be divided in 5 modules" Was replaced by "The physics of JULES can be considered to fall into 5 areas"

6. **p. 462, line 1. The first sentence is miss-leading as it suggests that photosynthesis in JULES depends mainly on CO2 concentrations. Whilst it does indeed depend upon CO2, this is not the main dependence. I would suggest that the word "mainly" is removed from the text.**

   The word "mainly" was deleted.

7. **p. 462, line 6. As mentioned in 4. above, TRIFFID is not identified as being part of the JULES model. As such, the words "TRIFFID module" should be replaced with "vegetation dynamics module"**

"TRIFFID" was changed by "vegetation dynamics".

8. **p. 462, line 21. The meaning of this sentence is not clear. JULES explicitly includes runoff processes, that will be partly generated by rainfall. So I am not sure why the authors say this is being developed and is not currently available.**

   This information was obtained from https://jules.jchmr.org/model-description/hydrology. Perhaps the text in web page is not updated. The text "At present these options are not available" was removed of the document.

9. **p. 463. Section 2.4. It is not clear if JULES has been coupled to CCATT-BRAMS explicitly or implicitly. This should be stated in the text.**

   We are not sure about what exactly you meant by explicit /implicit coupling. The coupling we did is on-line, with CCATT-BRAMS passing to JULES the current atmospheric state and getting back the surface fluxes for that time provided by JULES. This might resembles what you are calling an explicit coupling. The following phrase was included in the text: "The JULES surface scheme has been fully coupled to the CCATT-BRAMS modeling system on an on-line fashion using an explicit scheme".

10. **p. 464, line 6. JULES also requires soil temperatures as initialization. As such, details of where these come from should be given at the end of the paragraph on line 15.**

    The soil temperature is initialized by the air temperature of the first level of the atmospheric model, in the same manner as the LEAF original model does. P. 464, line 6 was included in the phase: "...sea surface temperature, soil carbon,

soil moisture data and *soil temperature*." and in p. 464, line 15 was included: "*Soil temperature is initialized by the air temperature of the first level of the atmospheric model*"

11. **p. 465, lines 9,10. JULES can only use a timestep greater than half an hour for coarse resolution and when it is implicitly coupled to the atmospheric model. The actual timestep used for JULES will depend upon both of these and the text should be amended to reflect this.**

    According to Clark et. al (2011) (reference in p. 477, lines 13-17), a typical time step of JULES is from 30 to 60 min. Based on this information, we wrote that JULES is able to run with a time step bigger than half hour. But, you are right; in the coupled system the time step will be dictated by different factors. We deleted the paragraph on p. 465 lines 8-12.

12. **Section 3. Throughout this section, the results from the ECMWF re-analysis are presented. It is not clear why this has been done. The re-analysis product is quite different from the other model results being considered here, for instance it uses screen level temperature and humidity data to nudge its soil moisture in the data assimilation steps. As such, it is not a clean (or perhaps even fair) comparison. As such it is not clear that the inclusion of these results add anything to the paper. In fact, I would argue that it just causes some confusion. As such, I would suggest that the results from the ECMWF re-analysis are removed from the manuscript. This would then also impact on the conclusion on p. 475 which mention the ECMWF results. This would also need to be removed.**

    ECMWF is a reference atmospheric model for South America. The idea of including ECMWF reanalysis was compared the performances of JULES-

CCATT-BRAMS and ECMWF model, which is considered to present the best skill for the region of interest.

13. **Figure 5. the x-axis of this figure needs a title with units. The y-axis title should be replaced with something that is more meaningful (e.g., height above the surface) General comments:**

    Figure 5: "RMSE Wind Speed [m/s]" was included in x-axis and in y-axis "lev" was replaced by "height above the surface".

Technical corrections:

- **p. 459, line 20. This sentence does not make sense. I assume that the word "em" in the middle of the sentence is a miss-type, but it is not clear what it should be.**

  The phrase was changed to: "The general mass continuity for tracers solved in the model, in tendency form, is:"

- **p. 460, line 11. "as well as not does no cause" should be replaces with "as well as not causing"**

  Corrected accordingly.

- **p. 461, line 10. "Meteorological Office" should be replace with "Met Office"**

  Corrected accordingly.

- **p. 462, line 28. "soil humidity" should be replaced with "soil moisture".**

  Corrected accordingly.